SECTION 10: SCOPE OF WORK AND DESIGN CRITERIA

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1.0 Scope of Work

1.1 General

B- SMILE, Bengaluru Smart Infrastructure Limited, a Special Purpose Vehicle **(SPV)** created by Karnataka government, **B- SMILE** responsible to oversee and implement major projects in Bengaluru. As a comprehensive solution for **End to End traffic solution** to the city of Bangalore the **B- SMILE** is planning for 120 km of elevated roads in the various part of the city to provide End to end solutions.as a part of comprehensive development, **B- SMILE** intends to take up **"Elevated Corridor from Minerva Junction to Hudson Circle Junction integrating with flyover from Anand Rao Circle to Nrupatunga Road Via KR Circle, connecting flyover to Bala Gangadhara Swamy Flyover to JC Road at Bangalore**". In this behest, B-Smile is inviting Tender from the Eligible Tenderers on EPC/Lump Sum, Fixed Price. The Alternate Proposal submitted by the Tenderer shall conform to the Relevant Indian and International Standards satisfying the Key Parameters fixed by the B-SMILE and shall be approved by the B-SMILE. Location of the Site is described in 1.2 below.

Tenderers shall submit only one Proposal. Additional Proposal/s shall result in the Disqualification of the Tenderer.

The EPC/Turnkey/ Lump Sum/ Fixed Price, No Variation Tender based on Tenderer's own Design shall be inclusive of Cost of Topographic Survey; Geotechnical Investigation and any other Ancillary Investigations / Works and Cost of all Labours; Materials; Casting Yard; Tools and Plants and Machinery required for completing the various Components of the Elevated corridor along with Drainage Facilities; Slip Roads; Footpath; Signals and Signages; Road Marking; Painting of all the Infrastructure developed; Illumination in the Elevated Corridor, on Surface Level Roads; etc. including Junction Improvement and Road Works like Preparation of Sub Base, Base, Riding Surface; Construction of Medians, Islands, Road Side Kerbs, Culverts, White Topping the grade level road and adjacent Roads, Temporary and Permanent Retaining Structures, etc. The Works shall include all Civil, Electrical, Mechanical, all Safety Aspects and any other Works required for the Construction and Completion of the Works in all respects and to the satisfaction of the Employer. The Quoted Rate shall be inclusive of Construction and Maintenance of the Roads affected due to Traffic Diversions necessitated for this Work including Provision of Flagmen, Barricade, Illumination, Signals and Signages required for the Traffic Diversion. The Quoted Rate shall be inclusive of all Taxes, Duties and Levies including Sales Tax, Municipal Taxes, Local Taxes, Octroi, ESI, all Royalties, Patent Rights, other Incidental

Charges, and any other Taxes wherever applicable and shall be paid by the Contractor. No claim whatsoever in this regard shall be entertained by the Employer.

1.2 Site

The location being central part of the city, traffic flow in this corridor is from southern Part of Bangalore towards SJP Road, Kempegowda Road, Magestic, Vidhana Soudha & M.G Road. Also, the Present traffic flow pattern from other direction, i.e., traffic from KR Circle, Sheshadri Road, Race Course Road, Vidhanasoudha is such that, it has to go via Lalbagh to reach southern parts i.e., Jayanagar, Basavangudi, Banashankari JP Nagar etc. Attempt has been made to bring the traffic directly on Elevated corridor on JC road integrating with flyover from Sheshadri Road, leading the same to RV Road thereby minimising the travel time and avoiding the traffic signals. Also, with one arm connecting existing BGS fly over which starts from Mysore circle will directly leave the traffic to the various roads, KG Road, Kastur ba Road using the elevated rotary, proposed at Hudson circle. The Fly over connects the Tunnel Road, towards Hebbal being planned by Government of Karnataka which is a vital link for vehicles going towards Hebbal.

The main junctions along this corridor are- Minerva Junction, Bharath Talkies Junction, Shivaji Talkies Junction, Town Hall Junction, LIC (Badami House Junction), Ulsoor Gate Police Station, KG Road, Nrupatunga Road, Rajaram Mohan Roy Road, KR Circle, Freedom Park Junction, SJP Road.

1.3 Works to be carried out

The Works to be carried out under this EPC/Turn Key, Lump Sum, Fixed Price, and No Variation Contract shall include

a. Preliminary Works like Setting out, Establishing and Maintenance of Permanent Benchmarks, Reference Points and Centre Lines of the Flyover, Surface Level Roads, Drainage Facilities and all other Items of the Work.
b. Clearing of Site before Commencement of Work including Dismantling and Site Clearance in the Acquired Property, if any.
c. Topographical Survey and Setting out of Works.
d. Geotechnical Investigations and taking Trial Bores: The Geotechnical Investigation Results given in this Document is only indicative and the same is enclosed in Annexure C. The Tenderer shall make his own Assessment and his Lump Sum Offer is for the whole Item of the Work, (All the Items described in this Tender Document and Drawings) and for any Variations observed at Site in respect of Levels and Soil Particulars, etc. The Tenderer's

offer is deemed to have been made considering the Actual Ground Conditions at Site and he shall not be eligible for any claim whatsoever. During Execution of the Work, the Contractor shall carry out Geotechnical Investigation as per IRC: 78 at all piers / abutments, Selected Points of Retaining Wall and at any other Locations required for the Design of the Works in conformity to the Prevailing Norms and Codal Provisions.

e. The Successful Tenderer, on Award of Work, shall map all the Existing Service Lines, above and below the ground level within the Battery Limit, such as Water Supply, Underground Drainage, Electrical, Telephone, Optical Fibre Cables, etc. Mapping of the Service Lines below the Ground Level shall be carried out using Ground Penetrating Radar (GPR) Equipment. Mapping shall be got approved by all the respective Service Departments at the Risk and Cost of the Successful Tenderer.

f. Tree Transplantation Works including the cutting/ trimming Cost shall be the responsibility of the Contractor.

g. Removal and Relocation of Existing Bus Shelters within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

h. Shifting of Existing Kerb Stones within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

i. Removal and Relocation of Existing Traffic Signages and Signals within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

j. Removal and Relocation of Existing Hoardings, Advertisement Boards and Appurtenant Structures within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

k. Dismantling and Disposal of Debris of existing RCC and Masonry Structures, PCC, existing Road Pavements, RCC / SSM Drainage Structures, Tree Roots, Culverts, Medians, Kerbs, Traffic Islands, Earth Retaining Structures, Ducts, Hoarding and Advertisement Boards and Appurtenant Structures, etc. required for the Execution of the Work.

l. Construction of Temporary and Permanent Earth Retaining Structures, Compound, Barrication, Fencing, Dewatering, Drainage Facilities and all Temporary Structures wherever required during Construction.

m. Regarding of existing Ground Levels to achieve the required Vertical Clearance for Flyover, Drainages, etc. including Disposal of Excavated Earth and Debris to the Location identified by the Contractor where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned, Construction of Temporary and Permanent Retaining Walls as per the Approval of the Employer.

n. Traffic Diversion: The Contractor shall ensure that the Traffic Movement during the Construction of the Works is properly diverted, maintained and obstruction to the Traffic Movement is kept to the minimum. The Traffic Diversion with all Cost of Men and Material is to form part of the Turn Key Lump Sum Contract. The Traffic Diversion shall include but not be limited to the following.

- Prepare Traffic Diversion Plan for different Phases of Construction and got approved from the concerned Police Department by the Contractor.
- All Necessary Arrangements required for Diversion of Traffic, Erection of Sign Boards, Cautionary Boards and Illumination, etc.
- Provide Road Markings, Drainage System, Footpath for the Diversion Roads.
- Provide Skilled Flagmen for Traffic Diversion as per the Requirement of Concerned Department.
- Provide Traffic Barricades with Blinkers, Reflective Tapes, Road Delineators, Traffic Cones, Portable Signages, Reflective Lights and other necessary Traffic Signage as required, as directed by the Concerned Authorities and as per the Specification.
- Provide required Sub Grade and Surface Treatments for the Diversion Roads based on IRC Standards before Traffic Diversion and maintain for the Smooth Flow of Traffic throughout the Construction Period as directed by the Employer.
- After Completion of the Work, the Diversion Roads are to be rehabilitated as per IRC Standards using base layers & strengthening course and provided with 40mm Bituminous Concrete irrespective of other Treatments provided earlier during Pre Construction and Construction Period of the Work.
- It is the responsibility of the Contractor to work out the actual Traffic Diversion Schedule in concurrence with the Requirements of the Concerned Department and execute the same during different phases of Construction.
- Pedestrian Facilities shall be provided for Diverted Roads and the Plan for Pedestrian Facilities shall be got approved from the concerned Police Department by the Contractor.

o. Barrication around the Construction Area

- The Contractor shall be required to keep the Site as Safe and Secure as possible at all times, including the Erection of Site Perimeter Hoarding, which shall also deter trespassers both adult and children alike, as per the Approval of the Employer.
- The Contractor shall provide a solid two metre high securely erected Barricade including Lights over Barricades at night around the perimeter of the Site as per the Approval of

the Employer, with Agreed and Guarded Access and Egress Points for both personnel and vehicles.

- At each entrance to the Site, the Contractor shall erect a large Billboard warning all persons who enter the Site that they are required to wear the Appropriate Personal Protective Clothing and that no Unauthorized Access is allowed.
- Wherever the Barricade borders on Pedestrian Footpath, Lightings shall be provided to illuminate the Pedestrian Routes. The Positioning of the Barricade Line shall not reduce the Width of Pedestrian Footpath to less than 900mm.
- Site Perimeter Barricade shall be washed at least once a month and repainted at least annually.
- The Site Barricade shall need to be inspected on a regular basis in order to ensure that the Integrity of the Fencing is maintained at all times as far as practicable.

p. Work adjacent to Live Railways: Whenever Work is to be conducted in close proximity to the Live Railways then the following Measures shall be addressed.

- The Rules provided for in the Railways' Manual shall be followed.
- No persons shall encroach onto the Railway Area unless specific authority has been given by the Employer.
- Adequate Protection in accordance with the Railways' Requirements shall be followed (Provision of Block Inspectors, Flagmen, Lookouts, etc).
- All persons shall wear High Visibility Clothing at all times.
- Any Induction Training Requirements of the Railway Authority shall be strictly observed.

q. Providing and Erecting Project Information Display Board (minimum size 2.5m X 1.5m) at minimum Twelve (12) different locations in and around the Project Area as approved by the Employer.

r. The Successful Tenderer, on Award of Work, shall coordinate with KPWD, NHAI, Traffic Police, BDA, BESCOM, BSNL, BWSSB, BMRCL, KPCL, B-SMILE, south western railways and other Agencies associated with the Construction of Works and comply with their Requirements. The Employer will provide assistance only.

s. Construction of Flyover including Foundations, Sub Structure, **Super Structure with UHPFRC Fish belly structure for standard spans, UHPFRC/PSC/Composite Steel for elevated Rotary** Construction of Reinforced Earth Retaining Walls, RCC Retaining Walls, Backfill between RE Walls / Retaining Walls, Soil Stabilization below RE Panels, Filter Media, Kerbs, Crash Barrier, Complete Drainage System with Down Take Pipes, Wearing Coat,

Water Proofing, Hand Rails to Crash Barriers, Expansion Joints, Bearings, Painting, Deck and Surface Road Illumination, etc. complete in all respects as per MoRT&H / IRC / BIS Specifications.

t. Construction of Slip Roads and other Roads at Grade Level including Widening of Carriageway; Junction Improvements; Construction of Retaining Wall; Construction of Compound; Road Side Drain; Footpath; Hand Rails; Drains; Medians; etc. complete in all respects as per MoRT&H / IRC / BIS Specifications. The Scope shall include all the above Works within the Battery Limit.

u. Providing Gantry, Traffic Signals, Traffic Signages, Road Marking and Granite Tablets along with necessary Pedestals, Foundation Stone, Stone for Inauguration Ceremony as per Specifications and as per the Approval of the Employer.

v. Necessary Drainage Arrangement as per Specification. The Levels and Dimension Details for Drainage Arrangement shown in the Tender Drawing are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer before Execution.

w. Set up of Field Laboratory.

x. Adequate Street Lighting / Junction Lighting Arrangements as approved by the Employer during Construction.

y. Removal / Disposal: Removal / Disposal of Excess / Disused Earth, Soils, Debris and Materials from the Construction Site. Further, it is the responsibility of the Contractor to identify the Dumping Yard Location and to dispose the Excess / Disused Earth, Soils, Debris and Materials to the same identified Dumping Yard where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned.

z. Dewatering in Foundation, Trenches, Drainages, wherever required, and pumping out to Locations as directed by the Employer.

aa. All Necessary Safety Measures / Precautions to be adopted at Site as per the Instructions of the Employer.

bb. Providing and maintaining Furnished Site Office for the Supervisory Staff of the Employer and his approved Representative.

cc. Making good the Road Surface as per IRC Standards, which are damaged / worn out during Construction of the Work and restoring the same to the Original Status.

dd. Any other Items of Works, which are not specifically enumerated in the Tender Document, but required for Functioning of all the Infrastructures Developed and as per the Directions of the Employer.

ee. Construction of Architectural Features required for Good Aesthetics of the Infrastructure developed.

ff. Painting with Approved Colour, Shade, Make and Type shall be provided for the various Elements as per the Specifications given in the Tender Document.

gg. The Contractor shall ensure Cleanliness of the Work Area and its surroundings by deploying Man Power for the same. The Contractor shall have to ensure proper Brooming, Cleaning and Washing of Work Area till the Currency of the Contract including Disposal of Sweepage. Nothing extra shall be payable on this account.

hh. Cleaning of the Site after Execution and before handing over the Project to the Employer.

ii. Maintenance of all the Infrastructural Facilities developed for a Defect Liability Period of 24 months, which will run concurrently from the Date of the Physical Completion of the Project and on issuance of Completion Certificate by the Competent Authority.

Note: Any other works which are necessary for satisfactory completion of the work but not specifically mentioned in the above shall also be part of scope of work.

2.0 Design Criteria

2.1 General and Approach to Work Site

The General Site Particulars are shown in the Drawing No. VAX/B-SMILE/JCR/DPR-01.

2.2 Benchmarks and Setting out of Works

a. The Standard Benchmark and its Reduced Level with reference to which the Work shall be carried out is the GTS Benchmark available nearest to the Site. The Employer does not take the responsibility about the Correctness of the Levels indicated in the Drawings. The Contractor has to establish at least Twenty (20) Benchmarks in the Site of Works with Reduced Levels clearly marked on them. The Contractor shall be solely responsible for the accuracy of the Benchmark Levels and for maintaining the same throughout the Contract Period.

b. The Works shall be set out in accordance with the Drawings approved by the Employer.

c. The Contractor shall be responsible for the True and Proper Setting out of the Works and for the Correctness of the Positions, Levels, Dimensions and Alignments of all Parts of the Works and for the Provision of all Necessary Instruments, Appliances and Labours in connection therewith. The Contractor shall give at least 48 hours notice to the Employer of his intention to set out or give Levels.

d. If at any time during the Progress of the Work, any Error appears or arises in the Positions, Levels, Dimensions and Alignments of any part of the Work, the Contractor shall at his own expenses and risk, rectify such Errors to the satisfaction of the Employer.

e. The Checking of any setting out of any line or level by the Employer or his approved Representative shall not relieve in any way the Contractor of his responsibility for the Correctness thereof and he shall carefully protect and preserve all the Benchmarks, Site Rails, Pegs and other Things used in the setting out of Works.

f. All Duties concerning Establishment of a Set of Benchmarks, Permanent Stations, Centre Line Pillars, etc. for performing all the Functions necessary at the Commencement and during the Progress of Work till the Physical Completion of all the Items of the Work in question, shall be carried out by the Contractor at his own risk and cost.

g. The Centre Line of the Piers of Flyover, Abutments, RE Walls, Pedestrian Facilities, Surface Level Roads, Drainage Facilities and the Foundations shall be established by Total Station Equipment and the Centre Line Marks shall be engraved on smoothly finished masonry or concrete pillars of such dimensions and constructed at such intervals and places as may be directed by the Employer or his approved Representative and shall be maintained in proper manner throughout the Period of Construction. The Contractor shall submit a Drawing showing the Alignment of flyover, Pedestrian Facilities, Surface Level Roads and Drainage Facilities; Locations of Pier / Abutment / Wall within 15 (Fifteen) days from the Date of Signing of Agreement.

h. He shall also keep proper Record of such Permanent Benchmarks established denoting therein their Correct Levels.

i. The Work of Establishment of all such Benchmarks shall be carried out by only experienced and skilled staff of the Contractor with the help of precise instruments suitable for this type of Work. The instruments used shall be checked for their accuracy and for permanent adjustments before the commencement of the Work and also at frequent intervals during the progress of the Work.

j. All such Benchmarks established by the Contractor shall be subject to check and approval of the Employer or his approved Representatives. If any Variations noticed in the Work as result of improper establishment or maintenance of such Benchmarks, it shall be rectified at the Contractor's own Risk and Expense.

2.3 General Requirements

In order that the Tenderer's Proposal qualifies as an Alternative Design, it shall generally fulfil the following Requirements.

a. It shall ensure Soundness of the Structure, its Durability and Aesthetics as a whole in harmony with the surroundings. A Report on the Aesthetic Aspect shall be compulsorily in the Technical Bid.

b. It shall ensure Speedy and Practicable Construction.

c. It shall lead to Appreciable Economy in the Design.

d. It shall be accompanied by Detailed Drawings and Detailed Description of Work and Specification of Materials and Items. If called upon, the Tenderer shall explain his Proposal through Power Point Presentation during Tender Evaluation Stage before Opening of Financial Bid.

e. At the time of Detailed Design, the Contractor shall not deviate from the Basic Scheme proposed by him for the purpose of Tender. At the same time, it is mandatory on the part of the Contractor to strictly adhere to all the Geometric Details indicated in the Tender Drawing. The Length of the Ramp could marginally change based on his Structural Scheme and Designs after Approval by the Employer.

f. The Alignment of the Elevated Corridor, Rotary, Surface Level Road and Drainage Facilities, Electrical, Compound wall shown in the Drawings appended with the Tender Document shall be followed by all the Tenderers and if any alternations/ Modifications in alignment plan is proposed by the bidder in the better way resulting with further reduction of the cost of land acquisition and project cost will be subjected to employer approval.

g. The Superstructure shall be designed with minimum numbers of Expansion Joints to ensure smooth, Safe, Low noise and uninterrupted riding quality for vehicular traffic.
Expansion joints shall be provided only at the structurally essential locations based on the design requirements, Temperature effects, Creep, Shrinkage, seismic Considerations and over all structural behavior.
The Contractor shall adopt modern joint systems such as modular strip seal expansion joints, Strip seal joints , Link slab arrangements, Integral/ Semi intergral deck systems or equivalent approved technology conforming to relevant IRC/MORth Specifications to achieve enhance riding comfort, water tightness, durability, Reduce maintains and long service life.
Conventinal joints excessive noice , leakage, vibrations, riding discomfort, or high maintance requirements shall not be permitted unless specifically approved by

Engineer in charge.

h. Only Single Pier Type Structure shall be considered for Elevated Rotary Flyovers, unless otherwise approved by Employer. The pier configuration and geometry shall be architecturally and aesthetically Design to suit the urban environment with reference give elliptical, circular, stream lined or Architecturally treated, ornamental Piers of Classical / Modern appearance, etc. The Design shall ensure structural stability and durability minimum obstruction traffic movement below and visual harmony with surrounding infrastructure, the final selection and approval for the pier shapes architectural treatment and aesthetic appearance shall rest solely with the Employers and decision of the Employer in this regards shall be final and binding on the contractor.

i. The Tenderer shall note that it is a Requirement for Qualification that the Works warrant that the Structure proposed shall be aesthetically pleasing and easy to maintain considering the Importance of the Work Location.

2.4 Specifications for Design and Codes to be followed

The Design of Structural Components of all the Works shall conform to the Relevant Specifications and Criteria laid down in the following Latest Indian Road Congress Publications with Amendments / Revisions issued upto the Date of Issue of Notice Inviting Tenders.

The Hierarchy for the following Codes of Practice is as follows:

a.

IRC: 5 General Features of Design

IRC: 6 Loads and Stresses

IRC: 15 Construction of Concrete Roads
IRC: 22 Composite Construction (Limit State Design)
IRC: 24 Steel Road Bridges
IRC: 35 Road Markings

IRC: 37 Design of Flexible Pavements

IRC: 38 Design of Horizontal Curves for Highways and Design Tables

IRC: 44 Cement Concrete Mix Design for Pavements

IRC: 54 Lateral and Vertical Clearances at Underpasses for Vehicular Traffic

IRC: 58 Design of Plain Jointed Rigid Pavements for Highways

IRC: 67 Road Signs

IRC: 78 Foundation and Substructure

IRC: 79 Road Delineators

IRC: 83
(Part I) Metallic Bearings

IRC: 83
(Part II) Elastomeric Bearings

IRC: 83
(Part III) POT, POT cum PTFE, PIN and Metallic Guide Bearings

IRC: 86 Geometric Design Standards for Urban Roads in Plains

IRC: 92 Design of Interchanges in Urban Areas

IRC: 103 Pedestrian Facilities

IRC: 112 Concrete Road Bridges

IRC: SP: 23 Vertical Curves for Highways

IRC: SP: 42 Road Drainage

IRC: SP: 50 Urban Drainage

IRC: SP: 56 Steel Pedestrian Bridges

IRC: SP: 57 Quality Systems for Road Construction

IS: 2911 (All Parts) Pile Foundations

NF P 18-470 - Concrete — Ultra-high performance fibre-reinforced concrete — Specifications, performance, production and conformity

NF P18-710 - National addition to Eurocode 2 — Design of concrete structures: specific rules for Ultra-High Performance Fibre-Reinforced Concrete (UHPFRC)

The Latest Revision of the above Codes shall be followed.

b. Any IRC Standard Specifications and Codes of Practice or Criteria for Road Bridges other than "a" above, but published upto the Last Date of the Issue of Notice Inviting Tender.
c. For any Item not covered by “a” and “b” above, MoRT&H Specifications for Road and Bridge Works published by Ministry of Surface Transport (Roads Wing), Government of India (Latest Edition).
d. For Items not covered by any of the “a”, “b” and “c” above, Standards and Specifications, Provisions of Bureau of Indian Standard (BIS) Codes of Practice.
e. IRC: SP: 33 Guidelines on Supplemental Measures for Design, Detailing and Durability of important Bridge Structures (if applicable).
f. For Items not covered by any of the above Standards and Specifications, Sound Engineering Practice and Provisions of Relevant Codes of other Nations shall be referred. In this regard, Decision of the Employer shall be final and binding on the Contractor.

Criteria for UHPFRC:

The design shall conform to provisions of IRC codal provisions/any international standards, material specifications, durability requirements, testing procedures, structural behaviour, connection systems, fatigue performance, ductility, serviceability, casting methodology, curing requirements, and quality assurance procedures for Ultra High Fibre Reinforced Concrete (UHFRC/UHPC) components shall conform to internationally accepted practices and guidelines such as fib Model Code, AFGC Recommendations, FHWA Guidelines, French code, Swiss code or equivalent approved international standards in addition to applicable IRC and IS provisions.

The Contractor shall submit complete design basis reports, material characterization reports, trial mix reports, durability studies, fatigue performance studies, prototype testing results, and proof-check documents for approval by the Employer and Third-Party Proof Consultant prior to commencement of fabrication or construction works involving UHFRC/UHPC technology.

2.5 Order of Precedence in case of Conflict

In Case of Conflict between difference parts of Tender Document, the following Order of Precedence shall prevail.

1. Design Criteria as specified in Tender Document.
2. Instructions to Tenderers.
3. Special Conditions of Contract.
4. General Conditions of Contract.
5. MoRT& H / IRC Specifications.
6. Codes of Practice.

For Items not covered by any of the above Standards and Specifications, Sound Engineering Practice and Provisions of Relevant Codes of other Nations shall be referred. In this regard, Decision of the Employer shall be final and binding on the Contractor.

2.6 Soil Investigation to be carried out by the Contractor

The Contractor shall carryout complete Soil Investigation at his own risk and cost. The Boreholes shall be taken at the Final Locations of each Pier / Abutment, at Selected Points of Retaining Wall, at required Intervals along the Surface Level Roads required for the Pavement Design and at any other Locations required for the Design of the Works prior to the Commencement of the Work to ascertain the Levels of Rock and its Quality, to obtain SBC at different Depths, Soil Stratification, Ground Water Table, etc. The Termination Level of the Borehole shall be determined by conducting SPT Tests. Three consecutive SPT Tests at an interval of 1.5m each with 'N' values greater than 100 shall be carried out before termination. If rock is encountered, Drilling shall continue upto 3m in rock with Rock Samples taken for Testing. All the Soil / Sub Soil Investigations and its Frequency shall be strictly in accordance with the Relevant Codal Provisions.

a. During Execution of the Work, the Samples from the Bore taken at each Foundation shall be tested and analysed in the Laboratory approved by the Employer for establishing Design Parameters. Tests such as Standard Penetration Test, Compression and Shear Test on Undisturbed Soil Samples, Pressure Meter Test, Crushing Strength of Rock, California Bearing Ratio (CBR) Test, Plate Load Test, etc. shall be carried out in conformity with the MoRT&H Specifications. The Contractor shall submit the entire Data to the Employer along with his own / Laboratory Recommendations and obtain approval for the Design Parameters. Necessary Interpretation of the Result of Tests shall be furnished to the Employer for scrutiny of Design of Foundations.

b. The Cost of these Tests and Interpretation of the Test Results shall be considered, as incidental to the Main Work and the same shall be included in the Tendered Amount.

c. While checking the Stresses at the Base of Foundations, it shall be ensured that under the Worst Combination of Forces no Tension is permitted. The Safe Bearing Capacity at the Foundation Level shall be verified during Construction so that to ensure that the Stresses imposed on the Foundation Strata are within Permissible Limits.

2.7 Restrictions on Type of Structures

The following Types of Structural Arrangements shall not be permitted.

Structures, which require imported material of major quantity for which foreign exchange will have to be arranged by the Employer.

A Design in which Stability of one or more Span is endangered due to the Failure of some other Span / Spans.

Concrete Structures with Hinges / Half Joints / Articulations.

Super Structures with Joints at the tips of long cantilevers with Hinges including Pendulum Type Bearings, Gap Slab, etc.

Transversely Continuous Wide Deck resting on separate Foundations at Support Locations.

Piers in the form of Multiple Columns or "Y" Columns.

Any UHPFRC/UHPC structural system, connection detail, precast jointing arrangement, or construction methodology not supported by adequate analytical studies, prototype testing, fatigue verification, durability assessment, proof checking, and internationally accepted engineering practice.

Any structural arrangement resulting in difficult inspection access, complex replacement procedures, excessive lifecycle maintenance requirements, or long-term operational constraints for urban elevated corridor applications.

Preference shall be given to continuous, durable, low-maintenance, aesthetically pleasing, and near-jointless structural systems utilizing UHPFRC/UHPC technology with enhanced durability, riding comfort, structural redundancy, and lifecycle performance suitable for dense urban environments

2.8 Scope of Construction for Elevated corridor

2.8.1 Structural Components

The Structural Components of the 2Lane/ 4 lanes divided bi directional shall be as shown in the DPR drawings.

The scope of this EPC Contract shall include detailed engineering, proof checking, design, procurement, construction, testing, commissioning, and completion of the Proposed construction of Elevated Corridors from Minerva Circle to Hudson Circle and loop flyover from existing Bala Gangadhara Nath Swamiji flyover to Townhall and Construction of Elevated Corridors from Sangolli Rayanna circle (Anand Rao Flyover) to Nrupathunga road (KR Circle)" in Bengaluru city including viaducts of elevated road, approaches to elevated road,entry and exit ramps, High level Roatary, portal frame structures, approaches, utility integration works, drainage arrangements, road restoration works, electrical and illumination works, traffic management systems, and all

associated civil, structural, architectural, and urban infrastructure works complete in all respects in accordance with the Conceptual Drawings, Scope of Work, Technical Specifications, applicable IRC/MoRT&H/BIS Standards, and directions of the Engineer-in-Charge.

The Super structure of the elevated road in general is proposed with Ultra High Performance Fibre Reinforced Concrete(UHPFRC). The type of the structure is Fish belly type. The bottom slab and webs of the fish belly structure shall be with UHPFRC with minimum strength of M150 and top slab shall be High performance concrete either pre cast or Cast insitu. The connection between UHPFRC and HPC shall be done as per the relevant codal provisions and standard engineering practices. Corridor has a deck width of 7m, 8.5m, 14m and 17m of UHPFRC super structures, spans as described in table below.

High Level Rotary, at Hudson Church junction is proposed with

The Salient Features of the Flyover are given below (Ref Drg:VAX/B-smile/GAD-01)

1. **A. Flyover- Viaduct**

SNo	Description	Span(m)	Deck width(m)	Super Structure
1	Diagonal Road (VV Puram)	3x50	7.0	UHPFRC
		1x38	7.0	UHPFRC/Composite Steel
2	RV Road	1x50+1x40	14.1	UHPFRC
		1x50	14.1	UHPFRC/Composite Steel
3	JC Road to Hudson Circle	23x50+3x40+6x30	17	UHPFRC
		2x30+1x34.7+1x38	8.5	UHPFRC/Composite Steel
		2x50	72.7	Composite steel
5	Rotary	8x47.5	15	Composite Steel
6	Kempegowda Road	2x50	8.5	UHPFRC
		1x60	8.5	UHPFRC/Composite Steel
7	Nripathunga road	2x50	8.5	UHPFRC
		1x60	8.5	UHPFRC/Composite Steel
8	Kasturba Road	450+1x40+1x30	8.5	UHPFRC
		1x52	8.5	Composite Steel

SNo	Description	Span(m)	Deck width(m)	Super Structure
9	Rajaram Mohan Roy Road	4x50+1x40	8.5	UHPFRC

		1x65	8.5	Composite Steel
10	KR Market Road	10x50+1x40+2x30	7	UHPFRC
		1x50+2x30	7	Composite steel
11	Ambedkar Road	2x50+1x40+1x30	8.5	UHPFRC
12	Sheshadri Road	13x50+1x40+3x30+1x15+2x50	8.5	UHPFRC
		1x40+1x50	8.5	Composite steel

B. Solid Ramp – RE Wall

SNo	Description	Length(m)	Width(m)
1	Diagonal Road	74.0	7
2	RV Road	68.8	14.1
3	K.G.Road	94.0	8.5
4	Nripathunga Road(Entry Ramp)	100.0	8.5
5	Kasturba Road	96.2	8.5
6	Rajaram Mohan Roy Road	176.2	8.5
7	Ambedkar Road	142	8.5
8	Sheshadri Road	100	8.5
9	Nripathunga Road (Exit Ramp)	107	8.5

Width of Median in 4 Lane 1.0m

Width of Crash Barrier 2 x 0.50m.

Vertical Clearance 4.5m

Maximum Longitudinal Gradient 1 in 25

The length and span arrangement shown in the DPR drawing is only for reference, any change in the length of the viaduct/solid ramp during detailed engineering does not constitute change of scope.

Sub Structure and foundation:

Sub structure shall be with RCC/PSC Cast insitu/Pre cast Single pier with pier cap shall be proposed in general. Wherever necessary, RCC Portal piers with Steel/RCC pier beam shall be provided.

Pile Foundation shall be proposed as per the detailed geo tech investigation during the detailed engineering. If Hard rock is met at shallow depth (within 3m), open foundation may be adopted.

The Structural Configuration for the Approach and Obligatory Portion of the proposed Flyover is shown in No. VAX/B-SMILE/JC/TCS-01

The Design Criteria and Obligatory Requirements to be adopted for the Tenderer's Proposal are furnished in the next Section.

The Works of the Elevated road to be carried out under this Contract shall include the following.

a. Construction of Viaduct and Obligatory Portion of the Elevated road, Elevated Rotary complete with Disposal of Surplus Earth; Wearing Coat over Deck; Crash Barrier with Railing over it; Construction Joint; Expansion Joints between Viaducts, Approach Slab, etc. and complete as per Specifications mentioned in the Tender Document.
b. Construction of Reinforced Earth Retaining Walls along with Approach Slabs, Friction Slabs; Pavement over Earth Filling and Ramp Terminal on either side; Side Drains for the Approaches as per the Requirements; Backfilling with Filter Media, Retaining Walls as per the Requirement; Disposal of Surplus Excavated Earth; Crash Barriers with Railing; Expansion Joints in Retaining Walls, Approach Slabs as per the Specifications mentioned in the Tender Document.
c. Wearing Coat of the Deck Portion of the Flyover comprises of 50mm thick in Single layer.
d. The Pavement crust of Solid Ramp Portion and pavement crust for slip roads shall comprise as shown in drawing No: VAX/B-SMILE/JC/TCS-01
e. Contractor shall dig a Bore Well below the Viaduct Portion of flyover and fix a Submersible Pump of Suitable Capacity at his own Cost, before Commencement of Construction. The Bore Well shall be handed over along with the Pump and Accessories in Working Condition to the Employer on Completion of the Works.
f. Construction and Painting of Kerbs; Providing Over Head Gantry, Traffic Signages, Road Marking such as Lane Marking, Direction Marking & Pier Protection works, etc. as per the Specifications mentioned in this Tender Document.
g. Illumination above and below flyover as per the Specifications mentioned in this Tender Document and as approved by the Employer.
h. Dismantling and construction of compound walls

2.8.2 Design Data

Design of Flyover shall be based on latest IRC / BIS Codes, Special Publications by IRC, relevant and latest Ministry Circulars and Latest Edition of MoRT&H Specifications.

a. Location:

The Locations of the Flyover are given in the Drawings Ref: VAX/B-smile/TOPO-01

Road Geometrics:

Design Speed

Design Speed in general shall be 60Kmph unless any constraints to accommodate the same. Minimum speed of 40Kmph may be adopted at the constraint location. At High level rotary location, speed shall be as per IRC:65.

The Standards for Road Geometrics adopted in the Design of the Flyover and Ramps should be essentially based on IRC: 92 "Guidelines for the Design of Interchanges in Urban Areas" and the Salient Features are as follows.

i. Ruling Gradient Maximum allowable Gradient for all Entry and Exit Ramps shall maintained as per the drawing & IRC guidelines.

ii. Clearances Minimum Vertical Clearance between Road Formation Level and bottom level of Soffit of Flyover shall be 5.5m.

b. Minimum Viaduct Span

Minimum Span of Viaduct adopted shall not be less than as indicated in the Drawings and shall be approved by the Employer.

c. Obligatory Span Minimum Length of Obligatory Span shall be as shown in the Drawings and shall be approved by the Employer.

2.8.3 Description of Work and Obligatory Provisions for Alternative Proposals

a. Alignment and Location

The Alignment, Longitudinal Section and Obligatory Portion are shown in Drawing No. VAX/B-SMILE/JC/GAD-01

b. Layout of Elevated road

The Layout of Flyover shall satisfy the following criteria as indicated on the enclosed Drawings and Supplementary Data.

i. Minimum Vertical and Horizontal Clearance in the Obligatory Span Location.

ii. Minimum Length to be covered by Open Spans as required from Consideration

of Aesthetics and from Visibility for Low Level Traffic.

iii. Ruling Gradient/as per IRC:86.

iv. Minimum Length of Summit Curves and valley curves shall be provided as per ISD, wherever constraint vertical curves may be provided for SSD

v. Any other Criteria as shown on the Drawings.

2.8.4 Design Loads

a. Live Load

The Flyover shall be designed as per IRC: 6 (Latest Edition).

b. Wind Forces

Wind Forces shall be considered as per IRC: 6 (Latest Edition).

c. Seismic Force

The Flyover shall be designed for Appropriate Seismic Forces as per the Provisions of IRC: 6 (Latest Edition) and IRC: SP-114

d. Earth Pressure

i. The Soil Properties for Embankment shall be in accordance with MoRT&H Specifications. The Properties of Embankment like Dry Density of Soil Density 2.00 T / cum., $\phi = 30^0$ and C = 0 shall be considered for Design Purpose.

ii. Saturated Density of the Backfill (minimum 2T / cum) shall be considered for calculating Active Earth Pressure.

iii. For Passive Pressure, Procedure given in Appendix 4 of IRC: 78 shall be followed.

iv. Passive Relief for Socketing shall not be permitted for Foundations resting on Rock.

v. Cohesion of Backfill Earth shall not be considered in Calculating Earth Pressure.

vi. No Skin Friction shall be taken into account for the Calculation of any Relief for Vertical Load upto Rock Level. The Angle of Wall Friction in no case shall exceed 2/3 of Angle of Internal Friction of Soil in Embankment.

e. Temperature Range

i. For Design of Structure to account for Temperature in formula Movement (DL) = αLt

The value of "t" shall be as per IRC 6 corresponding to Bangalore

Where α = Coefficient of Expansion or Contraction

L = Length of the Member

(DL) = Expansion / Contraction due to Temperature Variation in appropriate

Units.

ii. The Superstructure shall also be designed for Effects of Distribution of Temperature across the Deck Depth as per the Relevant Codal Provisions. For Calculation of Thermal Force Effect, 'E' Value of Concrete shall be taken as 50% of the Instantaneous Value so that to account for the Effects of Creep on Thermal Strains.

2.8.5 Durability

a. Minimum Grade of Concrete shall be as below.

PCC for Levelling Course	M15
RCC for Open Foundation, Sub Structure and Super Structure	M35
RCC for Pile and Pile Cap	M35
Prestressed Concrete	M35
UHPFRC	M150
Grade of Reinforcement Steel	Fe500/550
Pre stressing steel	Stress relieved low relaxation steel, class II

b. Minimum Cement Content, Diameter of Bar and Cover Requirements

For Plain Cement Concrete (PCC), Reinforced Cement Concrete (RCC) and Pre-Stressed Concrete (PSC), the Value given below regarding Minimum Cement Content and Maximum Water Cement Ratio shall be followed.

Plain Concrete		RCC / PSC	
Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio	Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio
360	0.45	380 / 400	0.45 / 0.40

c. The Minimum Nominal Diameter of Reinforcement shall be 8mm.

d. The Minimum Clear Cover to Reinforcement for all Grades of Concrete shall be as below.

Structural Element	Clear Cover
Slab	40mm
Web / Column	40mm
Footing / Raft slab	75mm
Cable Duct	75mm

Pile Foundation	75mm

Durability aspects shall be as per relevant clauses of IRC: 112

2.8.6 Foundation

a. General

The Piles shall be bored Cast – in – Situ type and depth of the pile shall be sufficient to mobilise required Vertical and lateral capacity due to Loads. The Construction of Pile Foundation shall conform to relevant Specifications of IS: 2911 unless specified otherwise in the Documents.

b. Quality of Pile Concrete, Pile Caps, etc.

The Grade of Concrete for the Pile shall be minimum M35. The Cement Content for Piling Work shall be minimum 400 kg / m3 with Ordinary Portland Cement.

Grading and other Requirements of Coarse and Fine Aggregates, Water and Concrete shall be as specified for Concrete Works in the Contract Document.

c. Length / Dia of Pile

Pile Diameters: Piles of minimum 1000mm dia or above shall be used for the Flyover as the foundations to be executed in the city center.

i. Boring

Boring Equipment and Accessories shall generally conform to IS: 2911 (Part I / Section – 2). Boring may be done by either Rotary or Percussion Equipment. In case of Unstable Soils, the Boring Tools used shall be such that Suction Efforts are minimised. Stabilization of the Sides of the Boreholes shall be done by the use of Bentonite Slurry or Casing. The Size of the Cutting Tool shall not be less than the Diameter of the Pile by more than 75 mm.

ii. Drilling Mud

The Drilling Mud shall be used at least from the Level of Subsoil Water or from the Level of Bottom of Guide Casing depending upon the Site Conditions and the Hole shall then be always kept almost full with the suspension, which shall preferably be kept in motion. The Density and Composition of the Suspension shall be such that to suit the Requirements of the Ground Condition and to maintain the Fine Materials from the Boring in Suspension. A 5% Bentonite Suspension would be generally suitable and its quality shall conform to the Specification given in Appendix A of IS: 2911 (Part I / Section 2).

iii. Cleaning of Borehole Bottom

The Bottom of the Hole shall be cleaned very carefully before Concreting Work is taken

up. The Cleaning of the Hole shall be ensured by careful operation either by Flushing with the Fresh Drilling Mud through the bottom of the hole or by Air Lifting Process. To lift the Spoil at Founding Level before Concreting, Borehole shall be agitated by jetting with Fresh Drilling Mud with relatively higher pressure than that used during Boring or Air through Tremie Pipe. While boring by use of Drilling Mud, the Specific Gravity of the Mud Suspension in the vicinity of the bottom of Borehole shall be determined at Suitable Interval and Record. Consistency of the Drilling Mud Suspension shall be controlled throughout the Boring and during Concreting Operation, in order to keep the Hole stabilised as well as to avoid Settlement of the Mud.

d. Founding Level for Piers / Abutments

The Technical Proposal / GAD shall indicate Founding Level at each Pier / Abutment Location. The Turn Key Lump Sum offer shall include for possibility of Cost of Variation if any between the Actual Founding Level and the Founding Level considered for the Purpose of Bidding. No Extra Payment shall be made in this regard after Finalisation of the Turn Key Lump Sum Contract Price.

e. Ramp / Retaining Walls

The Solid Ramp Portion of the Flyover shall be constructed with Reinforced Earth Retaining Structure designed aesthetically. The Abutments and Returns shall be designed for Live Load Surcharge equivalent to Earth Fill of 1.2m height respectively. The Minimum Density of Filling for Calculations of Surcharge Pressure shall be 2 t / cum. The Surcharge Effect shall be considered for the Purpose of Evaluating Earth Pressure only and not for Vertical Loads.

f. Open Foundation

Open Foundation may be permitted, where rock is encountered at a shallow depth and as per the decision of Engineer – In – Charge.

g. Pile Foundation

i. Only Bored Cast – in – Situ Piles shall be accepted.

ii. The Pile Foundations shall be designed as per the Requirements of IS: 2911 (Part I / Section 2) (Latest Edition).

iii. The Contractor shall carry out the Initial Pile Load Test at his own expense. The Design Capacity assumed for the Piles shall be verified by the Initial Load Testing of Test Piles in non working areas, in the vicinity of the Flyover Site. These Piles shall be tested for 2.5 times the Design Load. Additional Two Piles for each diameter, which are actually going to be used for Piers and Abutments, shall be tested for 1.5 times the Design Load.

Minimum Number of both these Tests to be carried out for each Diameter of Pile shall be four (4)

iv. Annular Piles filled or unfilled shall not be accepted.

v. Design with Single Row of Piles shall not be accepted.

vi. Design shall ensure that no Pile is subjected to Tension.

vii. Concreting shall be done, by Tremie Method after ensuring proper Tip Zone Cleaning by Flushing only.

viii. The Top of Concrete in Pile shall be brought above the cut off level by minimum 750mm to permit removal of all Laitance and Weak Concrete before Pile Cap is laid.

2.8.7 Substructure

a. Dimensions

i. Dimension of any Element of Sub Structure shall not be less than 300mm.

ii. All RCC Piers shall be of Solid Type.

iii. The Height of Pedestals on Pier Cap supporting Bearings shall not be more than 400mm.

b. Protection to Pier

For the Piers located in the Crossing of Low Level Roads, Protective Island of a minimum height of 1.2m and having a Clear Distance of 750mm from the Face of Pier shall be provided. The Gap between the Pier and the Island Wall shall be filled with Sand. Suitably Designed and Aesthetically Pleasing Fencing made out of Steel Members and painted with Protective Paint shall be fitted on the Top of Wall of the Island. The Island Wall shall be of Reinforced Concrete of M30 Grade having a thickness of 250mm and buried below adjacent Ground Level by 750mm.

c. Layout and Design

i. All Bearings shall preferably be supported directly on Pier Stem. Bearings resting on overhangs are acceptable provided the Differential Deflection of Pier Cap is accounted for in the Transverse Analysis of Superstructure.

ii. Dead Man Anchors or Friction Slabs shall not be accepted behind Abutment for relieving Moments.

iii. Scope for Accessibility for Inspection of Bearings and Arrangement for Lifting of the Superstructure for Future Replacement of Bearings shall be provided for in the Design of Sub Structure and Superstructure. The Positions of Flat Jacks shall be distinctly marked on the Drawing and the Structure.

iv. Tall Piers shall be checked for Deflection under Horizontal and Eccentric Forces as per IRC 112. Pier, Bearings and Expansion Joints shall be suitably designed.

2.8.8 Superstructure

a. Deck Slab

Deck Slab Thickness shall not be less then 200mm.

b. Super structure

Type of the super structure shall be as per cl 2.8.1 and shape of the super structure shall be as shown in the DPR drawings/as per Engineer incharge. For UHPFRC Minimum thickness shall be based on strength and durability requirement, however, shall not be less than 125mm.

b. Box Girders

i. For Pre Stressed Concrete Structure where Cables pass through Webs, minimum Web Thickness shall be greater of 150mm + outer dia of Duct or 250mm, whichever is greater.

ii. The Cross Diaphragms shall be minimum, one number at each Support and at ends of Cantilever, if any. In addition to Abrupt Change in Soffit Geometry, Stiffening Frame or Diaphragm shall be provided to cater to the Forces arising out of Change in Direction.

iii. Minimum Thickness of Diaphragms at Supports shall be 500mm and those of other Locations shall be 300mm.

c. Composite Steel Girder

Composite steel girder shall be as per IRC :24 and IRC: 22. Site welding shall not be allowed. Grade of steel for built up section shall be with E350 and structural sections shall be E250.

c. Precast Segment

In order to achieve Better Speed of Construction, Pre Cast Segmental type Construction shall be adopted for Superstructure. The U trough of Precast **UHPFRC** shall be cast under controlled environment by maintaining room temperature to the ambient temperature by executing casting work in factory shed with air ventilation /AC and by providing chiling plant with appropriate concrete mixture capacity to maintain the homogeneity along the concrete required for 1 segment of U girder of specified length. At Precast casting yard along with the provision of steam curing , casting machineries such as casting mould, survey software, Over head gantries, ancillary civil work such as gantry wall , Stacking bed to stac required number of Segments, curing water tank, survey tower, Reinforcement Jig, Over head gantry of required capacity for the proposed span, Over head gantry of appropriate span, Diesel genset of 250 KVA, Welding machine, steel cutting, bending Machines , Concrete Pump/

Boom Placer/ Concrete bucket with tyre mounted cranes etc and stacking yard to complete the entire casting of U girders. Following Aspects shall be taken into account while Designing and Constructing using the following Techniques.

The entire operation of pre casting shall be carried out under the supervision of experienced engineers.

i. Requirements regarding Minimum Dimensions, Reinforcements, Prestress, etc. shall be as per relevant codes

ii. For Construction with Continuous Spans, the Portion over Piers, the Key Segments and End Segments at Expansion Joints may be Cast – in – Situ. All other Segments shall be Pre Cast. For Simply Supported Spans, all the Segments shall preferably be Pre Cast.

iii. All the Segments shall be match – cast.

iv. The Shear Keys at the Face of Segments shall be as under.

On each Web, Single Key or Multiple Keys shall be provided. These keys shall be designed to transmit Shear Forces.

- On the Top and Bottom Slabs, Keys shall be provided to maintain Alignment and Level.

v. Formwork shall be Robust and the Foundations of the Casting and Stacking Yard shall be designed to safely support all Applied Loads without Undesired Deformations or Settlements.

vi. In order to achieve Smooth Profile of Pre Stressing Cables and to prevent Entry of Cement Slurry at the Joints of Matching Segments, PVC Pipe shall be inserted through the Cable Duct of both the Segments (i.e. Matching Segment and Segment being cast) at the time of concreting.

vii. The Work shall be executed by specially Experienced Team of Pre Stressing Professionals.

viii. Bond Breaking Agents shall be used while casting the Segments so that the Segments can be easily separated after casting. Scheme for Pre Casting of Segments shall be approved by the Employer.

ix. The Joints between Adjacent Segments shall be treated with appropriate Epoxy Formulation to facilitate Erection and to fill Cavities, if any. While applying Epoxy, care shall be taken to see that the Epoxy does not block the Openings of the Cable Ducts. Epoxy shall be applied on the Interface of both the Segments and the Joint subject to a minimum Pressure of 2.0 Kg / Sqcm for a period of 24 hours till the Epoxy sets. This may

be achieved by Temporary Pre Stress or any other Means. Permanent Cables shall then be introduced in the Ducts and after Pre Stressing the required No. of Cables in the Specified Sequence, the Temporary Pre Stress may be released.

x. The Method of Erection of Segments shall be such that the Desired Geometric Profile of the Loop Deck is obtained.

xi. The Segments shall be checked for Stresses during Handling and Erection and Necessary Calculations shall be submitted for the Employer's Approval.

xii. External Pre Stressing Cable System is allowed for Segmental Pre Cast Superstructure.

xiii. Calculations for Segment Casting Dimensions shall be submitted for the Employer's Approval taking into account the Effect of Creep and Shrinkage.

xiv. Reference may be made to the Document "Guides to Good Practice Recommendations for Segmental Construction in Prestressed Concrete" published by FIP and 'State of the Art Report on Materials and Systems for External Prestressing".

Prestressing Steel

i. The Prestressing Cables to be used shall be made using Low Relaxation HT Strands of size 12.7mm / 15.2mm conforming to IS: 14268.

ii. The Maximum Permissible Jacking Force shall not exceed 90% of 0.1 % Proof Stress. 0.1 % Proof Stress shall be taken as 85% of Minimum Ultimate Tensile Strength (UTS).

iii. Arrangement for External Pre Stressing shall be got approved from the Employer.

Precast Girders

i. For Ease and Speed of Construction, it is recommended that Precast Concrete Superstructure may be adopted. While designing such Elements / Structure, Aspects of Durability and Minimum Maintenance shall be kept in view. Criteria of Minimum Dimensions as per 2.8.7 shall be applicable.

ii. Precast Panel Slab Deck / Girders and Cast – in – Situ Slab Construction shall be designed as Composite Construction.

iii. Cross Prestressing in Superstructure shall not be allowed in general. However, the Nominal Prestress provided to the extent of keeping various Girders together will be allowed.

iv. In Pre Cast Construction, the Performance of Joints is especially Critical for the Integrity of a Structural System. The Geometric Configuration of a Joint, in addition to the Selection of an Appropriate Interface Material contributes to the proper Short Term and Long Term Performance of the Structure. The Design of Joints shall allow for Movements due to Shrinkage, Thermal Effects and Possible Differential Settlements.

v. Proper Lifting Arrangements shall be arranged by the Contractor for handling the Pre Cast Unit. The Components shall be designed for Lifting and Erection of Loads and Stresses. Lifting and Handling Positions shall be clearly defined particularly at Critical Locations. Indelible Identity, Location and Orientation Marks shall be put on all Segments as and when necessary.

2.8.9 Bearings below Superstructure

Bearings under Superstructure shall be within the External Line of the Pier / Abutment. The Bearings shall be provided below the Diaphragm at Suitable Locations.

a. The Types of Bearings generally allowed are as follows.

Span	Type of bearing
For Effective Spans up to 18m	Elastomeric Bearings
For Effective Spans more than 18m	POT cum PTFE / POT

b. The Bearings shall be easily accessible for Inspection / Maintenance.
c. Scope for Lifting the Superstructure for future replacement of Bearings shall be provided in the Design of Bearing. The Scheme of Lifting shall be indicated in the Drawing to be submitted along with the Technical Bid.
d. Inspection of Bearings by the Director General of Supplies and Disposal (DGSD) during manufacture is essential. The Contractor shall have to produce Necessary Certificate and Inspection Marks from the DGSD at his own Cost.
e. The Bearings shall conform to the Requirements of the MoRT&H Specifications.
f. The Dimensions of the Top Plate of the Bearing shall be such that the Contact Surface of the Superstructure projects beyond the Edge of Bearing Plate by a minimum distance of 50mm at any Location.

2.8.10 Expansion Joint

Elastomeric slab type Expansion Joint conforming to Clause 2607 of MoRT&H Specifications shall only be allowed. Calculations for the Adequacy of the Expansion Extent for which the Joint is selected by the Tenderer shall be submitted in the Technical Bid along with Name of Manufacturer and their Technical Details. During Installation of these Joints, Manufacturer's Engineer shall be required to supervise the same including Thermal Pre Setting, if required.

2.8.11 Crash Barrier

Concrete Crash Barrier shall conform to Clause 809 of MoRT&H Specifications. Crash Barriers shall be provided with Employer's Emblem as per the Approval of the Employer

2.8.12 Drainage

Drainage of Storm Water collected on the Flyover is essentially based on

IRC: SP: 42 and IRC: SP: 50 – "Guidelines on Urban Drainage" . The Drainage Spouts shall conform to Clause 2705 of MoRT&H Specifications. The Tenderer shall indicate the Drainage Spouts and its Disposal to natural Storm Water Drain in the Drawings submitted with the Technical Bid.

The Drainage Spouts shall be connected to a Pipe of diameter not less than 150mm and taken down by Down Take Pipes of suitable diameter through the Pier or at Approved Locations. These Pipes shall be connected to Longitudinal Drains below Surface and the Water finally being disposed off into natural Storm Water Drain using appropriately designed RCC Box Culverts for Crossings.

At Ground Level, Catch Water Drain with GI Gratings at Top shall be provided at each end of the Flyover. Drainage of Water collected at the Deck Level shall be effectively conveyed to Tertiary Drains at Ground Level through Appropriate Box Culverts across Surface Level Roads. The Drains shall be connected to the nearest natural Storm Water Drain. The Turn Key Lump Sum Cost shall include for all these Items.

The entire System including all Arrangements / Details shall be included in the Cost.

2.8.13 Wearing Coat

A Bituminous Wearing Coat of 50mm Uniform Thickness in single layer shall be provided for Smooth Riding Surface and shall conform to Clause 2702.1 of MoRT&H Standard Specifications for Road and Bridge Works (Latest Edition). The Cross Sections indicated in the Drawings shall be strictly adhered to.

2.8.14 Approach Slab

The Approach Slab shall conform to Clause 2704 of MoRT&H Standard Specifications for Road and Bridge Works (Latest Edition).

2.8.15 Integrity Test

Low Strain Integrity Test shall be carried out for all the Piles in conformation to ASTM D 5882 from an Empanelled Consultant in the Ministry of Shipping, Road, Transport & Highways. The

Tenderer shall include the Cost of Conducting this Test in his Turn Key Lump Sum Tender.

2.8.16 Electrical Works

The Tenderer shall include the Cost of Lighting within the Covered and Open Portions of Flyover, Junction at Surface Level above the Flyover, etc. in his Turn Key Lump Sum Tender and shall carry out all the Electrical Works as per relevant Codal Provision. The Tenderer shall indicate the proposed Lighting Arrangements as per relevant IS Codes. The Lumination shall be average of 40 lux throughout the deck surface. The Pole height shall be 9m and octagonal poles shall be used for entire project of elevated corridor. High mast lighting shall be provided at High level rotary portion as directed by Engineer in charge.

LED-based energy efficient lighting systems with suitable poles, brackets, control panels, junction boxes, cabling, earthing, lightning protection and maintenance access arrangements shall generally be adopted.

The EPC Contractor shall coordinate with all concerned utility agencies for power supply arrangements, shifting/protection of existing electrical utilities and integration with existing street lighting systems within the project limits.

2.8.17 Painting

Painting with Approved Color, Shade, Make and Type shall be provided for various Elements of elevated corridor to enhance durability and aesthetics. Protective painting/coating systems with approved colour, shade, make and specifications shall be provided for various structural and architectural elements of the Elevated Corridor Project to ensure durability, aesthetics, weather resistance and minimum maintenance under urban environmental conditions

Sl. No.	Structural Element	Protective Coating / Painting System
1	Pier Caps, Piers, Portal Frames, Viaducts, RE Wall Panels/RCC Walls of solid ramps and RCC/PSC Structural Components in super structure	Anti-carbonation protective coating/approved concrete protection system conforming to relevant IRC/MoRTH Specifications and approved manufacturer recommendations.
2	Structural steel inserts, embedded steel components, utility brackets, railings, ladders and exposed fabricated steel items	Two coats of approved epoxy paint over compatible zinc-rich/epoxy primer system after proper surface preparation.
3	Painting to the Composite steel girders	Painting to the composite steel girder shall be done as per the guide lines of IS 1477 and MORTH

3	Kerbs, medians, parapets, footpaths, utility ducts, guard rails, grills and other miscellaneous MS items	Two coats of approved enamel/epoxy paint over suitable primer system as approved by the Engineer-in-Charge.
4	MS Hand Rails over crash barriers and maintenance walkways	Two coats of epoxy/polyurethane paint over compatible primer after proper surface cleaning and approved surface preparation method.
5	Exposed surfaces requiring architectural/aesthetic treatment	Texture coating, anti-graffiti coating, decorative finish or approved architectural protective system as specified in approved drawings/design documents.

All painting and protective coating works shall conform to relevant IRC, MoRTH, IS Specifications and approved quality standards. Surface preparation, curing, application methodology, dry film thickness, durability requirements and quality assurance procedures shall be carried out strictly as per approved manufacturer specifications and project requirements.

2.8.18 Involving Specialised Agencies

The Successful contractor shall engage specialised agencies for supply of materials like Bearings, Expansion joints, Pre stressing, erection as sub contractors satisfying the prequalification requirements as per tender documents and Engineer in charge. This project consists of UHPFRC structures. UHPFRC is being new technology and not so commonly being used regularly as on today.

Considering the specialized nature of Ultra-High Performance Fibre Reinforced Concrete (UHPFRC) girders proposed for the elevated corridor, the successful Contractor shall engage a competent and experienced specialized agency/sub-contractor for the detailed design, design support, manufacture, quality control, testing, transportation, erection support, and implementation of UHPFRC girder works. The proposed agency shall possess demonstrated technical knowledge and capability in UHPFRC/UHPC technology, including material design, structural design principles, prestressing systems, production methodology, curing requirements, durability provisions, quality assurance procedures, handling, transportation, and erection of UHPFRC structural elements. Appointment of such agency shall be subject to the approval of the Employer/Engineer-in-Charge.

The specialized agency shall have qualified structural engineers and technical personnel familiar with the design philosophy, codal requirements, international best practices, manufacturing processes, and construction methodologies applicable to UHPFRC structures. Preference shall be given to agencies that have successfully participated in the design, manufacture, supply, erection, or execution of UHPFRC/UHPC girders, precast bridge elements, advanced concrete bridge systems, or similar

specialized structural components in Government, Semi-Government, Metro Rail, Railway, National Highway, State Highway, Urban Infrastructure, or other public infrastructure projects. The Contractor shall submit documentary evidence such as work orders, completion certificates, client certificates, technical approvals, project reports, or other acceptable proof demonstrating the credentials and experience of the proposed agency.

The detailed design of UHPFRC girders and associated structural components shall be carried out in accordance with relevant IRC, IS, international standards, project specifications, and accepted engineering practices applicable to UHPFRC structures. The complete design, methodology, material specifications, quality assurance plan, testing programme, and construction methodology shall be independently reviewed and vetted by Design vetting institution, The specialized agency shall work in close coordination with the design-vetting institution and shall incorporate all observations, recommendations, and modifications required during the design review process. The Contractor shall also establish a comprehensive quality control and quality assurance system for production and construction of UHPFRC girders, including material characterization, trial mixes, prototype testing, production testing, durability assessment, and performance validation, as directed by the Employer and the design-vetting institution.

Notwithstanding the engagement of any specialized agency or the acceptance of any design by the Employer or the design-vetting institution, the Contractor shall remain fully responsible for the structural adequacy, durability, quality, safety, performance, and successful completion of all UHPFRC girder works under the Contract.

2.9 Load Test

a. General Requirements

I. Before commencement of production works and foundation execution, the Contractor shall, at his own cost and risk, carry out initial load tests, routine load tests, lateral load tests and integrity tests on pile foundations for the Elevated Corridor, elevated rotary/interchange structures, portal frame locations, second-level carriageway portions and associated structures in accordance with relevant provisions of IRC:78, IS:2911, IRC:SP:114, IRC:SP:84 and other applicable IRC/BIS Codes and Specifications.

II. In addition to pile testing, wherever the Employer/Authority Engineer considers any structural system, UHPFRC/UHPC girder configuration, portal frame arrangement, special span, rotary structure, curved segment, erection methodology or structural component to be of special or unusual nature, the Contractor shall carry out prototype testing, proof load testing, model studies, field performance testing, mock-up trials or structural behaviour studies as directed by

the Employer.

b. Pile and Foundation Testing

I. Initial load tests shall generally be carried out on designated test piles to establish safe axial load capacity, lateral resistance, settlement characteristics and design assumptions.

II. Routine load tests, pile integrity tests, cross-hole sonic logging tests or equivalent approved non-destructive tests shall be carried out on working piles as specified in relevant Codes and approved quality assurance plans.

III. The Contractor shall submit detailed test procedures, instrumentation details, loading arrangements, interpretation methodology and test reports for approval.

c. Superstructure and Structural Load Testing

I. If required by the Employer/Authority Engineer, the Contractor shall carry out load testing on any portion of the superstructure including UHPFRC/UHPC U-Girders, strutted box girders, I-Girders, portal frames, elevated loop structures, second-level carriageway structures or completed spans to verify structural behaviour, deflection, vibration characteristics, stability and performance under design loading conditions.

II. The load test methodology shall conform to relevant IRC Codes including IRC:SP:51, IRC:SP:37, IRC:112 and other applicable standards/guidelines

d. Circumstances Requiring Testing

The Employer may instruct additional testing or proof checking in the following situations:

I. Failure of concrete cubes/specimens or non-conformance with specified strength/performance requirements.
II. Premature removal of formwork, supports or staging.
III. Improper curing, casting defects or construction deficiencies.
IV. Doubts regarding structural integrity, workmanship, geometry control or material quality.
V. Introduction of modified structural systems, revised erection methodology or altered construction sequence.
VI. Verification of behaviour of UHPFRC/UHPC structural components, joints, diaphragms or special structural arrangements.

e. Cost of Testing

I. All mandatory tests specified under IRC/IS/MoRTH Specifications, approved Quality Assurance Plans and Contract requirements shall be deemed included in the Contract Price

II. Tests ordered due to defective workmanship, material deficiencies, construction negligence or failure to meet specifications shall be carried out entirely at the Contractor's cost.

III. Where special model studies, proof testing or performance testing are ordered solely for validation of innovative systems or special design requirements and the results are satisfactory, the Employer may consider reimbursement only if specifically approved under Contract provisions

f. Contractor's Responsibilities

The Contractor shall make all arrangements for testing including:

I. Preparation and submission of detailed test calculations, loading schemes, instrumentation plans and observation procedures.

II. Deployment of calibrated equipment, reaction systems, kentledge, sensors, monitoring instruments and safety arrangements.

III. Recording of settlements, strains, deflections, rotations, vibrations, crack behavior and other structural responses during and after testing.

IV. Submission of complete test reports, analysis and interpretation certified by the Designer/Proof Consultant

g. **Defects and Rectification**

Any defects, distress, excessive deflection, cracking, settlement or structural inadequacy observed during testing shall be rectified by the Contractor at his own cost through approved remedial measures, strengthening, redesign or replacement as directed by the Employer/Authority Engineer

h. Completion of Testing

Upon completion of testing, all temporary loading arrangements, kentledge, staging, instrumentation and associated temporary works shall be removed by the Contractor and the structure/site restored to the satisfaction of the Employer.

I. Special Provisions for Prestressed and UHPFRC Structures

II. Load testing of prestressed/UHPFRC/UHPC superstructure components shall consider temperature variations, creep, shrinkage, prestress losses, construction stage effects and time-dependent behaviour. Necessary corrections and monitoring provisions shall be incorporated while evaluating test results in accordance with relevant IRC recommendations and approved proof checking procedures

2.10 Surface Level Road

2.10.1 Regrading, Widening and Construction of Road at Grade Level including Junction Improvement

The Work of Slip Roads, other Roads at Grade and Junction Improvements in the Project Stretch including its Battery Limit to be carried out under this Contract is indicated in Drawing No. VAX/B-SMILE/JC/ P&P-01 and shall include the following.

a. Construction of new Slip Roads, Widening and Resurfacing of Existing Roads; Dismantling of Existing Structures coming on the Carriageway such as Compound, Drains, Footpaths, Kerbs, Medians, Parapet Walls; Construction of new Culverts / Bridges, Retaining Wall; Landscaping Works; Reconstruction of Bridge over Storm Water Drain for Linear Waterway of 9.6m, etc. The following Standards and Specifications shall be adopted for the Slip / Surface Level Roads.

- Slip Roads, Surface Level Roads beyond the Lengths of the Grade Separator Ramps are to be merged with Existing Roads through a Taper / Transition of 15 in 1.
- Slip Roads, Surface Level Roads in the Project Stretch including its Battery Limits for the New Construction shall comprise of 500mm thick Sub Grade (of CBR > 10), 200mm thick Sub Base (GSB), 250mm thick Wet Mix Macadam, Prime Coat and Tack Coat, 95mm thick DBM laid over Tack Coat and 40mm thick BC laid over Tack Coat.
- Slip Roads, Surface Level Roads in the Project Stretch including its Battery Limits for the existing Road Portion shall comprise of 95mm thick DBM laid over Tack Coat and 40mm thick BC laid over Tack Coat.

b. Construction of Footpath along with Road Side Drain covered with 100mm thick RC Precast Slab and Utility Ducts comprising of 2 Nos. of 200mm HDPE Pipes (Class of Pipe is PN 6 – 0) with End Caps for Electrical Cables and 4 Nos. of 110mm dia HDPE Pipes (Class of Pipe is PN 6 – 0) with End Caps for OFC below Footpath along with Inspection Chambers of clear dimensions 2m X 1m X 1.1m for Electrical Cables and 1m X 0.5m X 1.1m for OFC at maximum 40m c/c interval below Footpath and providing 60mm thick Interlock Pavers of Approved Size, Shape and Colour with a minimum Compressive Strength of 281 kg / Sqm over Footpath (leaving the Width of Road Side Drain); Medians; Kerbs; Tubular Steel Railing at the edge of Footpath including Construction of Compound, Storm Water Drains, Drain Cover Slabs, Road Signs, Traffic Signals, Overhead Gantry, Road Marking such as Lane Marking, Pedestrian Marking, Direction Marking, STOP and STOP Lines, etc. as per the Specifications given MoRT&H and Kerb Painting as per the Specifications mentioned in this Tender Document.
c. The Construction of Medians, Kerbs and Footpath shall conform to Clause 408, 409 and 410 of the MoRT&H Specifications for Road and Bridge Works and shall be shown in the Drawings submitted with the Technical Bid.
d. Dismantling and Reconstruction of Compound, Gates, Grills, etc.
e. Guard Rails shall be provided to separate the Carriageway from the Footpath all along the length within the Battery Limit as per Clause 809 of MoRT&H Specifications for Road and Bridges.
f. Reconstruction of Damaged portion of White topping work at proposed project stretch.

2.10.2 Resurfacing / Reconstruction / Widening of Surface Level Roads

The Tenderer shall include in his Cost the Cost of Resurfacing / Overlays of all Roads in the Battery Limit and Construction / Strengthening / Maintenance of Roads and Junction Treatment for smooth flow of Diverted Traffic during Construction. Further, it may be noted that the Resurfacing of Road shall be carried out periodically as per the Instruction of the Employer during Construction Period and also finally before handing over the Work. The Turn Key Lump Sum Amount quoted is deemed to include Repetitive Asphalting.

2.10.3 Medians, Kerbs and Footpath

The Construction of Medians, Kerbs and Footpath shall conform to Clause 407, 408 and 409 of the MoRT&H Specifications for Road and Bridge Works (Latest Edition) and shall be shown in the Drawings submitted with the Technical Bid.

- The Alignment and Width of Footpath are indicated in Drawing No. VAX/B-SMILE/JC/P&P-01 However, the Minimum Width of Footpath shall not be less than 1.5m.

2.10.4 Construction of Compound

The Contractor shall dismantle the existing Compound in the widened Portion of the Right of Way and the same shall be reconstructed as per the Layout.

2.10.5 Bus Bay

Bus Bay shall be provided at the Location and the Construction shall be as per the Specifications given in IRC: 86 (Latest Revision).

2.11 Traffic Signs, Markings and other Road Appurtenances

Traffic Signs, Markings and other Road Appurtenances shall conform to Clause 800 of the MoRT&H Specifications for Road and Bridges (Latest Edition) and shall be shown in the Drawings submitted with the Technical Bid. Road Markings shall conform to IRC: 35 (Latest Revision) and Road Signs shall conform to IRC: 67 (Latest Revision). The Tenderer shall submit the Detailed Drawings of the Signages required as per the relevant IRC Specifications. Overhead Gantry by indicating Destinations as per the Approval of the Employer shall be provided at the Location indicated in the Drawing. Signages shall be provided with Retro Reflective, Micro Prismatic Reflectionised Stickers. Advanced Direction Boards with similar Specifications as above shall be provided at Locations mandated by IRC and as directed by the Employer.

However, the minimum Traffic Signs at each Junction shall be provided.

2.12 Drainage System

The Contractor shall carry out Hydraulic Study in the entire Catchment Area, which is having influence on the Battery Limit of the Project, in order to assess the Quantity of Runoff to be drained off from the Battery Limit. For this purpose, the Contractor shall map the Storm Water Drainage System, which passes through the Battery Limit. He shall calculate total Quantity of Runoff, which precipitates on the Battery Limit Area and enters the Battery Limit Area. The Contractor shall work out a Comprehensive Drainage System for Disposal of Runoff collected in the Flyover, on Surface Level Road by Gravity Flow only and the Drain shall be connected to the nearest Natural Storm Water Drain and as per the Approval of the Employer.

All Drainage System shall conform to Clause 309 of MoRT&H Specifications for Road and Bridges (Latest Edition).

The Tentative Drainage Arrangement Details for Flyover at the Project Junction are given in Drawing No. VAX/B-SMILE/JC/P&P-01. However, the Levels and Dimension Details for Drainage Arrangement shown in the Drawings are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer before Execution.

The Tenderer shall indicate a Comprehensive Drainage Arrangement System in the Drawings to be submitted with the Technical Bid.

The Contractor shall provide 2 Nos. of Catch Drains with MS Grating near each Road under Bridge. The Lump Sum Cost quoted by the Tenderer shall include all the above Items. During the Construction, the Water, which is met with, shall be pumped into the Roadside Drains. At no point it shall be pumped into BWSSB Sewer / Sanitary Lines.

2.13 Submission of Designs and drawings of Elevated Corridor for Approval

After award of work, Successful Tenderer shall submit the following design reports for Approval

1. Design basis report of the bridge stating the salient features of viaduct, span arrangements, GAD indicating, longitudinal eccentrics, depth of girders, type of superstructure UHPFRC/STEEL, R.C.C., PSC, composite, type of bearings arrangement with sketch showing fixed/free ends, curvature if any and the details of parameters codes, load combinations cases, wind, seismic zone etc.

2. Soil report for the entire corridor with bore hole at each of pier locations, Solid ramp portion. The recommendations of the soil consultant for the open foundation/pile foundation if applicable clearly stating the pile length with safe loads for two three alternates.

3. The feasibility of the structure or components must be checked in all respects by the tenderer before submitting the design to Railway/ B-SMILE office and signed by the authorized signatories of Tenderer.

4. The drawing must be submitted in preferably A-I size only in prescribed/standard format.

5. The design/drawing of the test pile is to be submitted and location of the test pile to be finalized in consultation with engineer in charge.
6. Detailed design of the each of the structure shall be submitted in both soft and hard copies for the approval for proof consultant. The analysis file used for the design shall be submitted. Analysis softwares used shall be standard softwares such as STAAD/MIDAS

3.0 Documentation, Instrumentation, etc.

a. All Drawings shall be made in Latest Version of AutoCAD and the Soft Copies on CDs and ten Hard Copies of Prints of all Approved Drawings and "As Built" Drawings shall be supplied by the Contractor to the Employer at Free of Cost as per the Agreed Programme.
b. CDs and ten Hard Copies of all Approved Design Calculations shall be submitted by the Contractor to the Employer at Free of Cost as per Agreed Programme.
c. Five Video CDs of 180 minutes duration each of the Elements covering the Different Phases of Construction from Start to Finish shall be supplied by the Contractor to the Employer at Free of Cost.
d. Three Copies of "Maintenance Manual" describing Access Arrangements, Important Obligatory Precautions from the Point of View of Structural Safety and Procedure for Minor and Major Repairs of each Component of the Elements, Renewals of Finishes and Treatments periodically including Guarantee / Warranty Certificates shall be supplied by the Contractor to the Employer at Free of Cost.
e. Three Copies of "Quality Assurance Manual" covering Designs and Drawings, Mix Designs, Materials, Testing, Soil and Rock Properties, Statistical Quality Control, etc. shall be prepared by the Contractor and submitted to the Employer at Free of Cost well before Starting the Work.

f. Three Copies of "Safety Manual" covering necessary Safety and Precautions to be adopted by the Contractor as per Requirements and as per Standards during execution of the Work.

g. Three Copies of "Construction Manual" covering Various Aspects of Construction Methods, Difficulties faced and how they are overcome during Execution, etc. shall be supplied by the Contractor to the Employer at Free of Cost at the Time of Finalisation of Work.

h. The Contractor shall install Fixtures and Fastenings provided by the Employer for housing any Instrumentation that may be useful for the Employer at Contractor's Cost.

i. Fixing Arrangement for Internal and External Lighting shall be approved by the Employer and executed by the Contractor.

4.0 Programme of Submission and Approval of Designs and Drawings

Sl No	Details	Time from Award of Work
1	Award of Work	0
2	Submission of Topographic Survey Drawing along with the Soil Investigation Report, Hydraulic Study Report, Details of Utility Mapping	4th Week
3	Horizontal and Vertical Geometrics, GAD and Construction Methodology and Schedule	5th Week
4	Traffic Diversion Schemes / Traffic Management Schemes during Construction, Quality Assurance Manual, Safety Manual, Physical Model of the Project	6th Week
5	Inception Report and Detailed Design Parameters	6th Week
6	Design and Construction Drawings of all Foundations and Preliminary Design of whole Structure	10th Week
7	Design and Construction Drawing of flyover, all Piers and Abutments and ramps.	12th Week
8	Design and Construction Drawing of all Superstructures	14th Week
9	Design and Construction Drawing of Balance Items of Work	16th Week
10	Submission of As Built Drawings, Video CD, Maintenance Manual, Construction Manual	4 Weeks after Completion of Work

The Total Period available for Submission of all Detailed Design and Drawings from the Date of Award of Work is 16 Weeks, which will be submitted in accordance with the Approved Construction Schedule.

The Design shall be submitted in Sufficient Details and as lucidly as possible so that to enable Quick Proof Checking by the Employer or his approved Representative. All the Design Calculations along with Corresponding Construction Drawings marked as "Good for Construction" will be submitted. The Corrected Designs are to be submitted as Record Designs within 15 Days of Approval of the Drawings. If the Record Designs are not submitted within this Time Frame then a Penalty at the rate as decided by Engineer incharge per day shall be charged for every day of Delay in Submission of the Record Designs.

The Corrected Designs and Drawings would be cleared within 3 weeks of submission subject to

Compliance of all Points. Any other Component, which requires Redesigning on Account of Exigencies of the Site like Redesigning the Foundations for Utilities, etc. during the Duration of the Works, shall be approved as expeditiously as possible. Such Designs shall be submitted within 10 days of taking a Decision to redesign the Component.

Analysis and Design shall be done using Computer with stndard Softwares like, STAAD/MIDAS/SOFISTIK or any recognized standard software. The Contractor shall submit with Design, the Detailed Description of Method of Analysis with Explanatory Notes and submit Sample Manual Calculations for adequate number of Typical Cases. The Computer Programme as submitted will be further tested by Comparison with Solutions of Worked Examples. Drawings and Designs shall be in SI Units. Calculations shall be neat and clear, preferably typed and printed and supplemented by Full Explanatory Notes and Sketches wherever required. All Construction Drawings of Initial Submissions and Final Approval shall be in AutoCAD only.

If during the scrutiny of Detailed Design Calculations and Working Drawings, any Changes therein which are found necessary in the Opinion of the Employer, the same shall be incorporated without altering the Turn Key Lump Sum Quotations. It is entirely the Responsibility of the Contractor to submit properly Prepared and Completed Designs in good time to enable the Employer to approve them in time.

The Contractor shall submit 2 sets of Advance Copies of the Drawings and Design Calculations to the Employer or his approved Representative with a Forwarding Letter to the Employer. Once the Design and Drawings have been finalised by the Employer, the Contractor shall forward eight sets of Drawings incorporating Corrections, if any, for the Final Approval.

After Completion of each Stage of Work, 3 Sets of Record Plans and One Set of Final Design Calculations based on the Work as actually executed on Site, shall be supplied by the Contractor in Bound Volumes to the Employer.

Approval to Drawings, Designs and Design Calculations by the Employer shall not in any way relieve the Contractor of his Responsibility for the Correctness, Soundness and Structural Stability and Safety of the Structure.

The Approved Drawings and the Design Calculations of the Elements shall be the property of the Employer.

The Contractor's Designer or Consultant shall compulsorily attend all the Review Meetings conducted by the Employer from time to time without any extra cost and shall also remain present as and when required during the Checking of Designs for Clarifications, if required.

As Built Drawings shall be submitted within 4 weeks from the Date of Completion of Works. Penalty of Rs. xxxxxx/- shall be levied for every week delay in submission of As Built Drawings beyond the Stipulated Deadline. An amount of Rs. xxxxxxx/- shall be withheld from the Contractor’s Final Bill until

the As Built Drawings are submitted.

5.0 Construction Schedule

The Construction Schedule and the Methodology of Construction shall be so planned that there is Minimum Obstruction to Traffic during Construction and the entire Work can be completed in minimum possible time.

6.0 Site Office

The Contractor shall provide and maintain Furnished Site Office at the Project Location for the Supervisory Staff of the Employer and his approved Representative.

It shall have minimum 40 Sqm of Floor Area and shall include all Items like Electric Supply, Electrical Items, Telephones, Lights, Fans and Complete Wiring, Drinking Water Supply and Hygienic Toilet Facilities completed along with Furniture as listed below.

i.	Executive Table (for the Employer)	1 No.
ii.	Executive Chair (for the Employer)	1 No.
iii.	Table (for Employer's approved Site Representative, Accountant, Head Clerk and Visitors)	6 Nos.
i.	Ordinary Chair Type I (for the Employer, Accountant, Head Clerk and Visitors)	3 Nos.
iv.	Table (for all other Staff)	2 Nos.
v.	Ordinary Chair Type II (for all other Staff and Visitors)	6 Nos.
vi.	Steel Almirah 1980mm X 915mm X 485mm	1 No.
vii.	Steel Almirah 1270mm X 765mm X 440mm	1 No.
v.	Racks – 5 Tier 1800mm X 900mm X 375mm made of Slotted Angles and M.S. Sheets	3 Nos.
vi.	Ceiling Fans – 1400mm size.	3 Nos.
vii.	Computer with Printer, Scanner Core 15 – 650 Processor (4M CACHE, 3.20 GHZ) with 4GB DDR3 RAM, Hard Disc Capacity 500 GB, 22X DVD Writer, 17" size TFT Colour Monitor, HP / Laser Printer of 80 Columns, 104 Keyboard, Optical Mouse with Mouse Pad and HP Scanner along with Broad Band Connection	2 Nos.
viii.	Photo Copier	1 No.

In addition, the Contractor shall provide a well maintained Air Conditioned Car with Driver, Fuel, etc. round the Clock for a mileage of 2500km / month for use within the Municipal Limit of Bengaluru City during the entire Contract Period for the Employer and its Representatives for Supervision of Works and shall also be responsible for the Maintenance of the Car. In case of Breakdown or during Maintenance of Vehicle, Alternate Vehicle shall be provided. This shall be incidental to Work and nothing extra shall be paid to the Contractor in this regard.

Further, the Contractor shall provide and maintain Wireless Communication System during entire Contract Period (consisting of 2 Nos. of Mobile Phones with SIM Card with Bill Ceiling Limit of Rs. 2000/- per mobile per month) for use by the Employer and its Representatives. This shall be incidental to Work and nothing extra shall be paid to the Contractor in this regard.

7.0 Field Laboratory

The Contractor shall provide and maintain adequately equipped Field Laboratory as required for Site Control on the Quality of Material and the Works. It shall have a minimum of 40 Sqm Area. The Field Laboratory shall be located as directed by the Employer or his approved Representative. It shall be provided with Amenities like Water Supply, Electric Supply, etc. The Laboratory will have all Services, Furniture, Equipments, etc. Minimum of the following Items shall be provided in the Field Laboratory. Any Additional Items as required for Testing / Evaluation in line with the Standard Procedures and Codal Provisions shall also be provided.

7.1 General

i. Oven – Electricity Operated, Thermostatically Controlled,
   Range upto 2000C, Sensitivity 10C — 1 No.

ii. Plat form balance 300 kg capacity — 1 No.

iii. Balance 20 kg Capacity – Self Indicating Type — 1 No.

iv. Electronic Balance 5kg Capacity – accuracy 0.5 gm — 1 No.

v. Water Bath – Electrically Operated and Thermostatically
   Controlled with Adjustable Shelves, Sensitivity 100C — 1 No.

vi. Thermometers — 4 Nos. each
   a. Mercury – in – Glass Thermometer ranges 0 to 2500C
   b. Mercury – in – Steel Thermometer with 30 cm Stem, ranges up to 3000C

vii. Glass Wares, Spatulas, Wire Gauzes, Steel Scales, Measuring Tape,

	Casseroles, Pans, Enameled Trays of Assorted Sizes, Pestle Mortar Porcelain Dishes, Gunny Bags, Plastic Bags, Chemicals, Digging Tools like Pickaxes, Shovels, etc.	As Required
	viii.Set of IS Sieves with Lid and Pans 450mm Diameter with Sizes of	
	1).63 mm, 53mm, 37.5mm 26.5mm, 13.2mm, 9.5mm 6.7mm and 4.75mm Set	1
	2). 200 mm Diameter of Sizes 2.36 mm, 2mm, 1.18 mm, 600 micron, 425 micron, 300 micron, 150 micron and 75 micron	1 Set
	ix. Water Testing Kit for pH, SO3 and Cl	1 Set
	x. First Aid Box	1 Set
7.2	For Soils and Aggregates	
	i. Rifle Box	1 No.
	ii. Atterberg's Limits (Liquid and Plastic Limits) Determination Apparatus	1 Set
	iii. Compaction Test Equipment both 2.5 kg and 4.5 kg Rammers (Light and Heavy Compact Efforts)	1 Set
	iv. Dry Bulk Density Test Apparatus (Sand Pouring Cylinder, Tray, Can, etc.) complete	1 Set
	v. Speedy Moisture Meter complete with Chemicals	1 Set
	vi. Posthole Auger with Extensions	1 Set
	vii. Core Cutter Apparatus complete with Dolly, Rammer, etc.	1 Set
	viii. Flakiness and Elongation Test Gauges	1 Set
	ix. Standard Measures of 30, 15 and 3 litres Capacity along with Standard Tamping Rod	1 Set
7.3	For Cement and Cement Concrete	
	i. Slump Test Apparatus	1 Set
	ii. Compression and Flexural Strength Testing Machine of 200T Capacity with Additional Diameter for Flexural Testing	1 Set
	iii. Cube Moulds for Concrete Tests	40 Nos.
	iv. Surface Moisture and Density Meter for Soil, Aggregate and Concrete	1 No.

8.0 Casting Yard

The Contractor shall make his own Arrangements for the Construction and Maintenance of Casting Yard required for the Work. The Quoted Rate shall be deemed to be inclusive of the Element of Cost towards the above.

9.0 Disputes

In case of Disputes arising between the Contractor and the Authority approving the Designs, the matter may be referred to the Commissioner, B-SMILE. The Decision of the Commissioner, B-SMILE shall be Final and Binding on the Contractor.